The Leading Mode of Intra-seasonal Variability of the South Asian Summer Monsoon

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Outline:

(1) Ravi P. Shukla, **2013**: The Leading Mode of Intra-seasonal Variability of the South Asian Summer Monsoon, ***COLA Technical Reports, 50 pp. March 2013.***

(i) Spatial and temporal structure of the MISO (monsoon intra-seasonal oscillation)
(ii) Analysis of the wind and geopotential height patterns associated with the MISO in both the lower troposphere and the upper troposphere

(2) Ravi P Shukla and Jieshun Zhu , 2013: Simulations of boreal summer intraseasonal variability with CFSv2 over India and western Pacific: Role of air-sea coupling**.** ***To be submitted to GRL.***

(i) Model: CFS v2
(ii) Experiment design: Coupled vs. Uncoupled

(3) Ravi P. Shukla and James L. Kinter, 2013: On the Leading Mode of Intraseasonal Variability of the South Asian Summer Monsoon in 19 CMIP5 Models**.** ***To be submitted to J. Climate.***

❖ **Daily/Pentad anomalies** (obtained by subtracting the respective seasonal-varying climatological-mean fields from total field and also removed each year mean)

❖**EOFs analysis was performed on the:-**

(**OLR field, 850hPa wind and 150hPa wind fields**)

defined within a:-

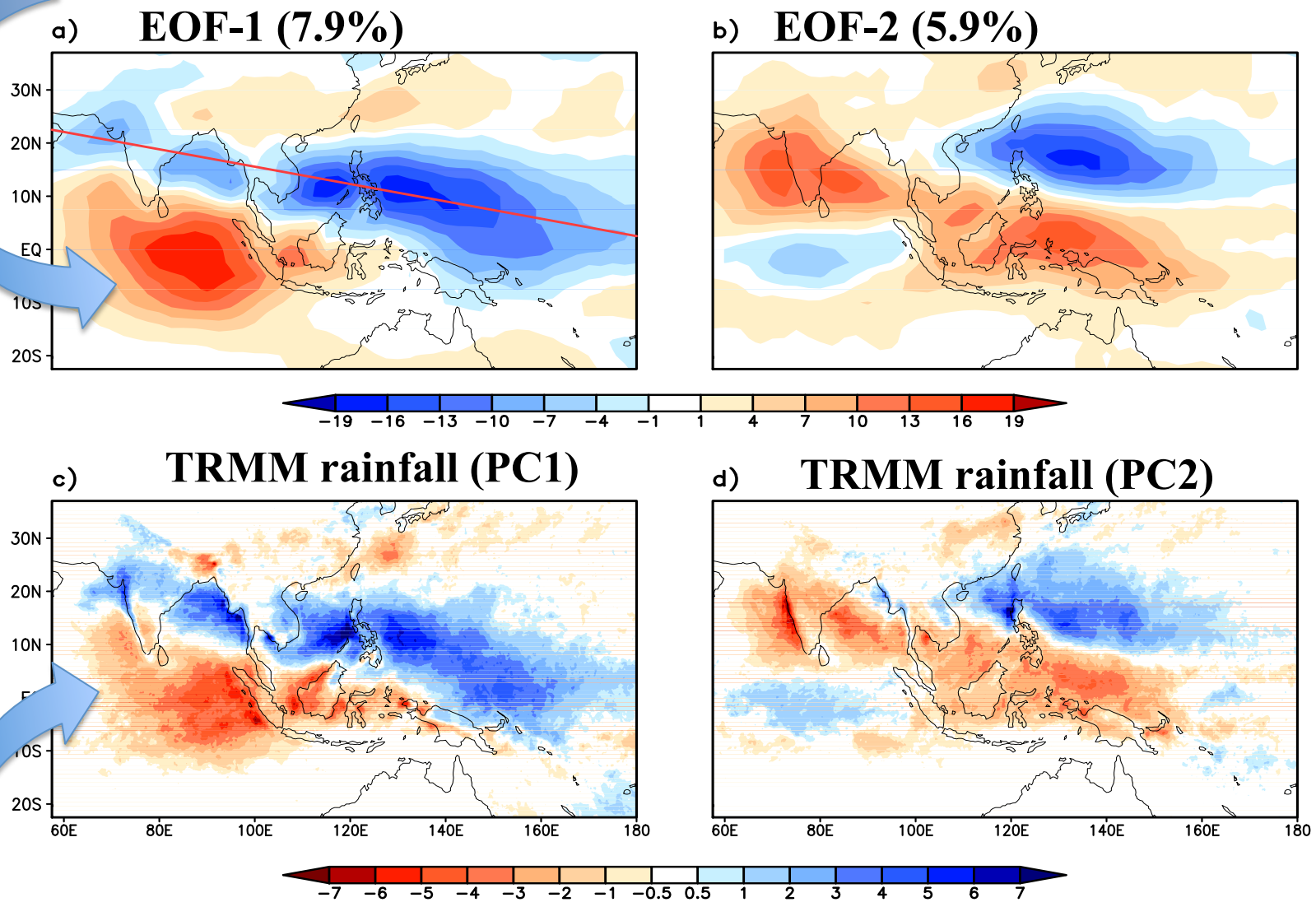
(number of different domains)

comprising South Asia during the monsoon season (JJAS)

❖**Most of the results shown in this lecture will base on:-**

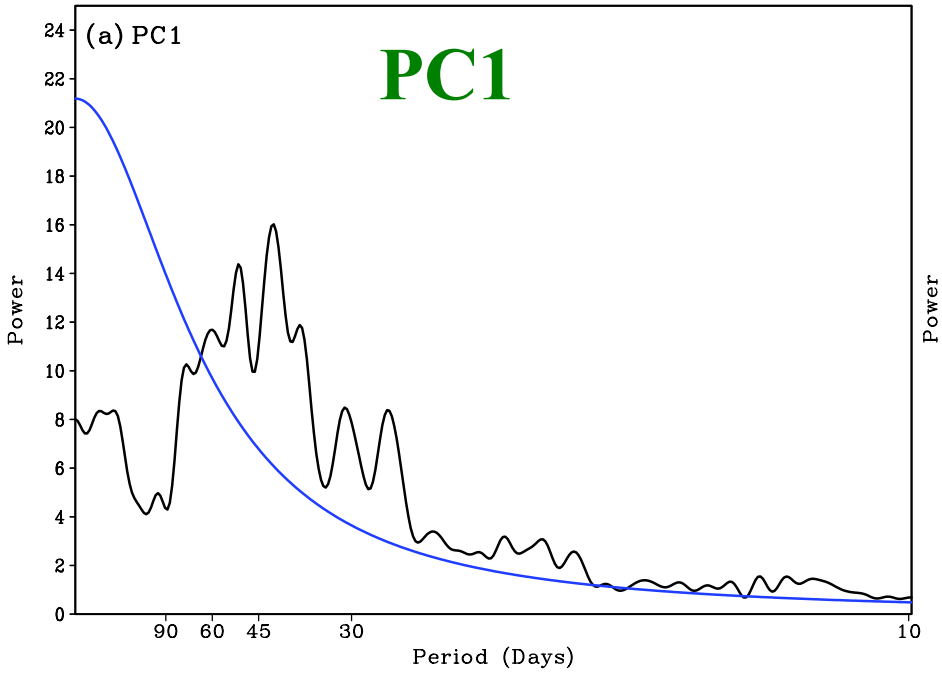
(The leading EOFs of OLR defined within the domain **57.5°E – 180°E, 22.5°S – 40°N**)

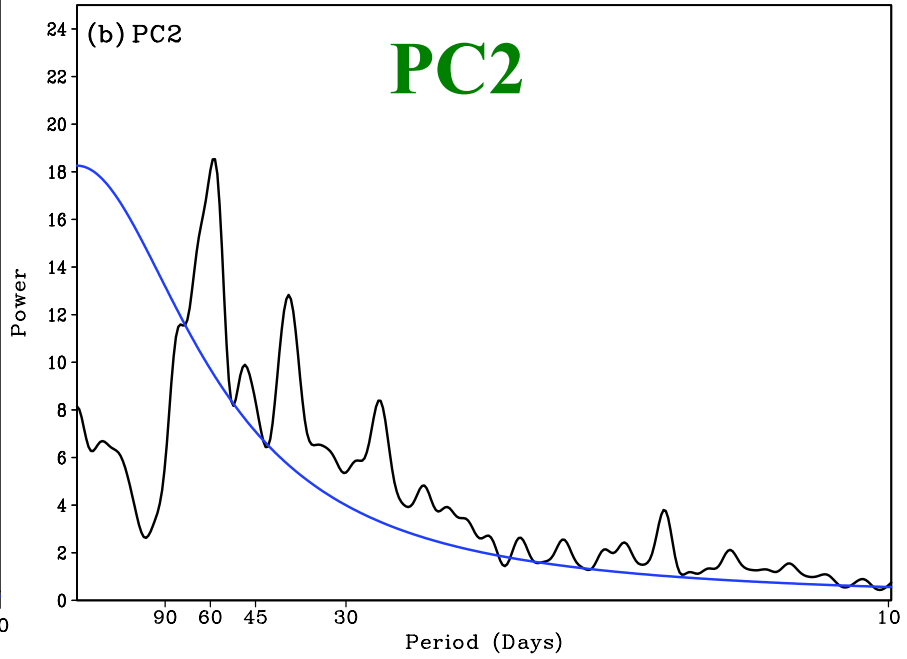
Leading EOFs (OLR based on pentad data for JJAS Season)



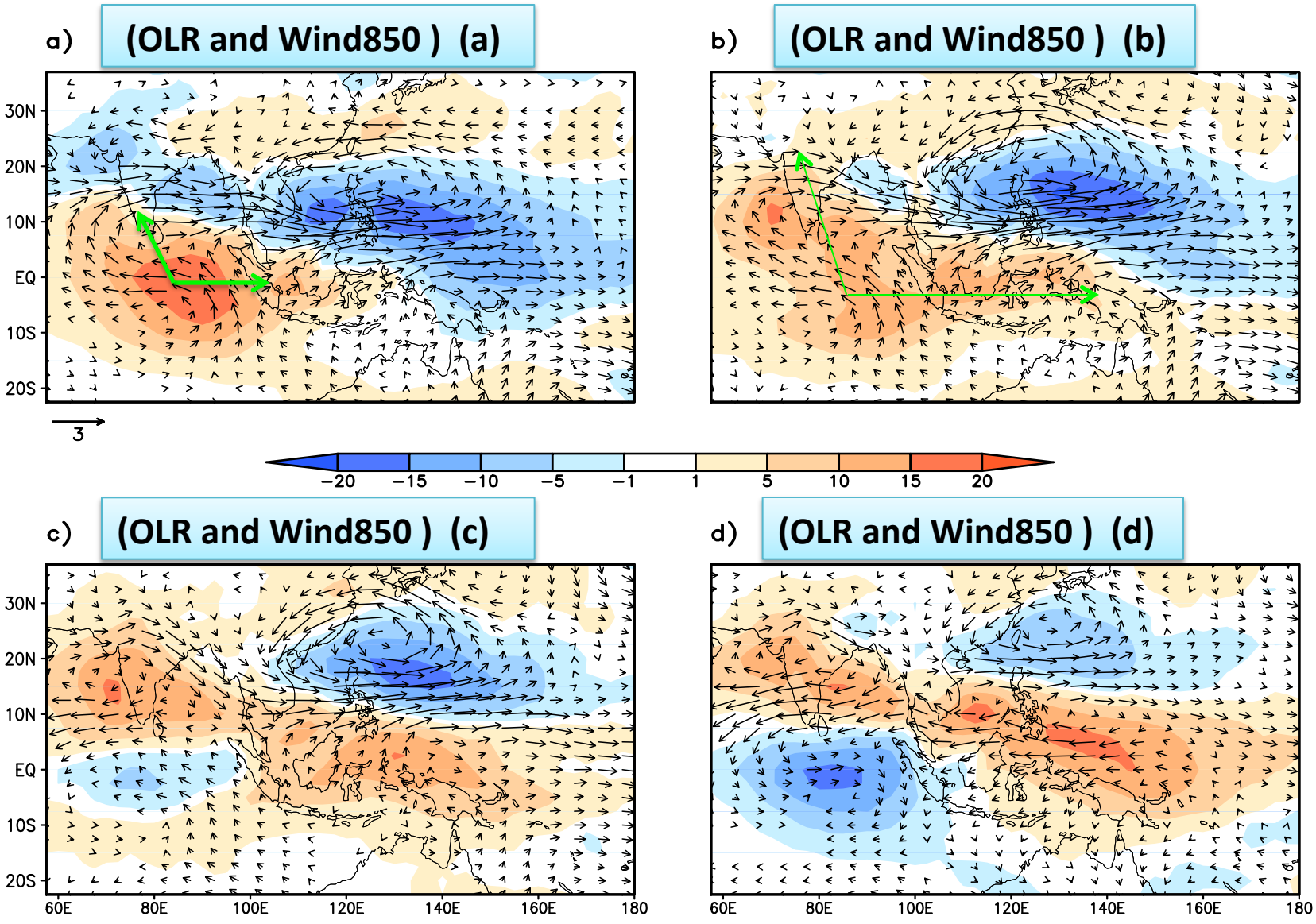
Pentad JJAS TRMM field regressed on standardized PC1 and PC2 of OLR

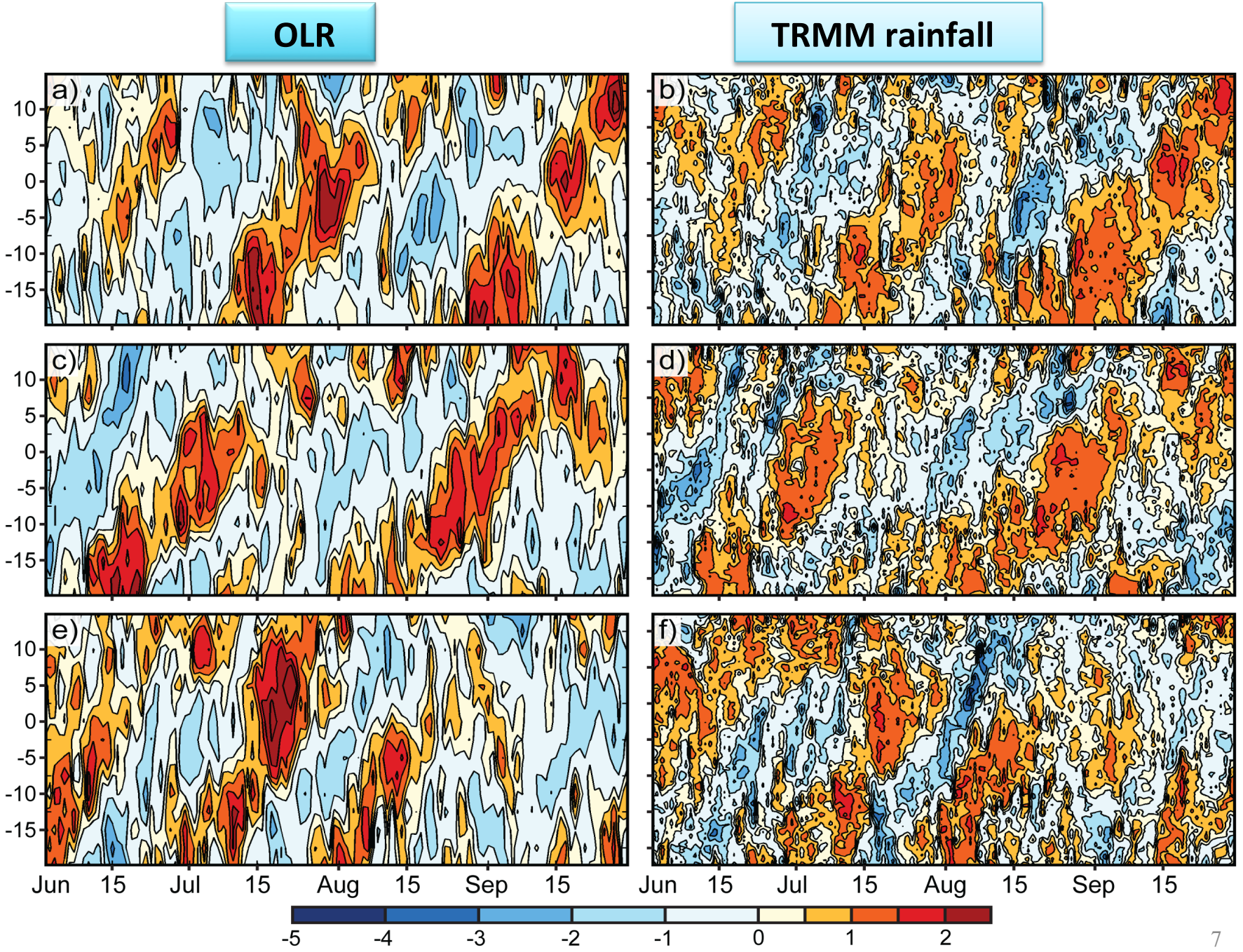
Power spectra of the PCs of the leading two EOFs of the JJAS OLR



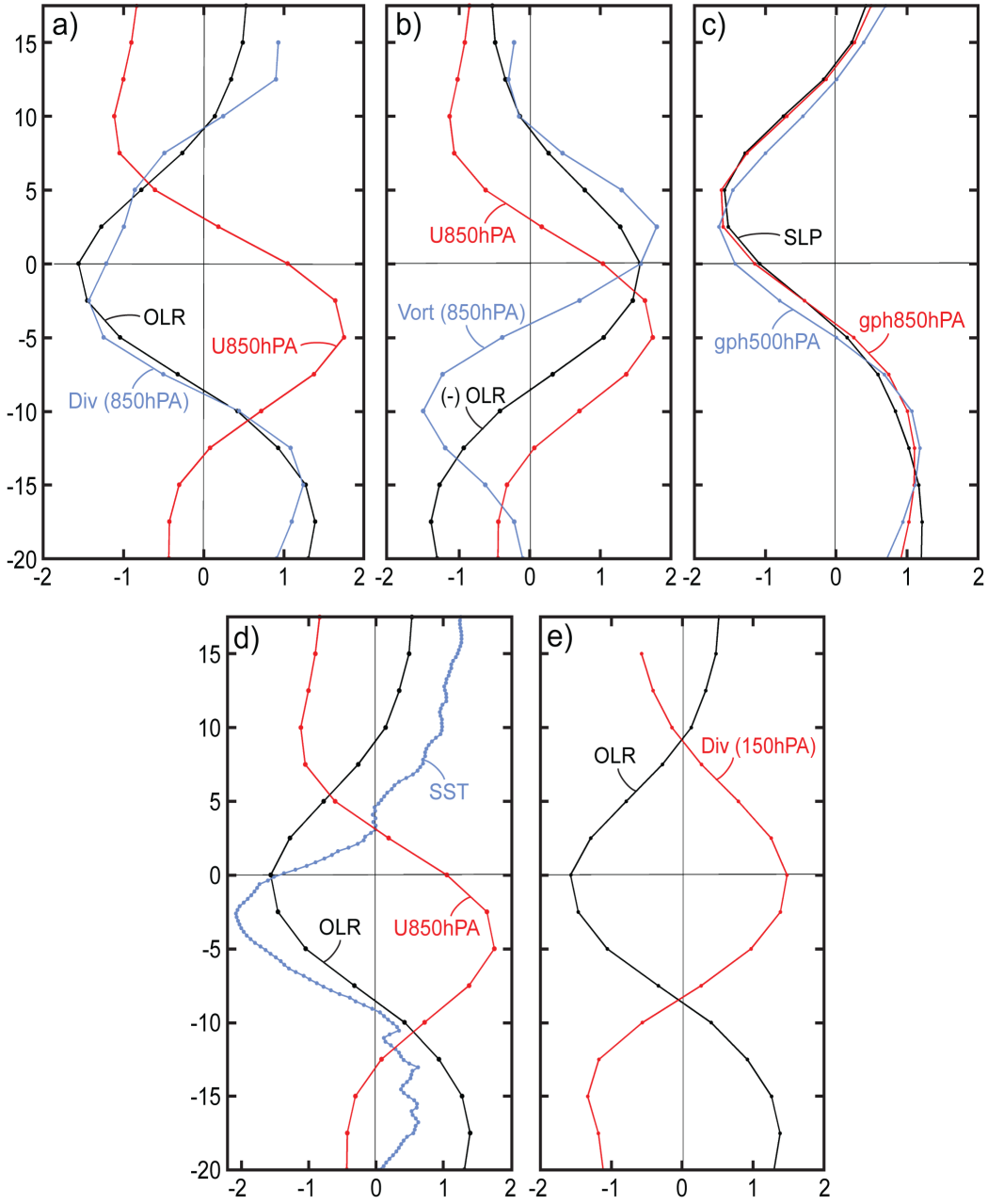


Projection of OLR (colored shading) and 850 hPa wind vectors upon standardized linear combinations of PC1 and PC2 of pentad-mean JJAS OLR: (*a*) PC1; (*b*) PC1 + PC2; (c) PC2; (*d*) –PC1 + PC2.

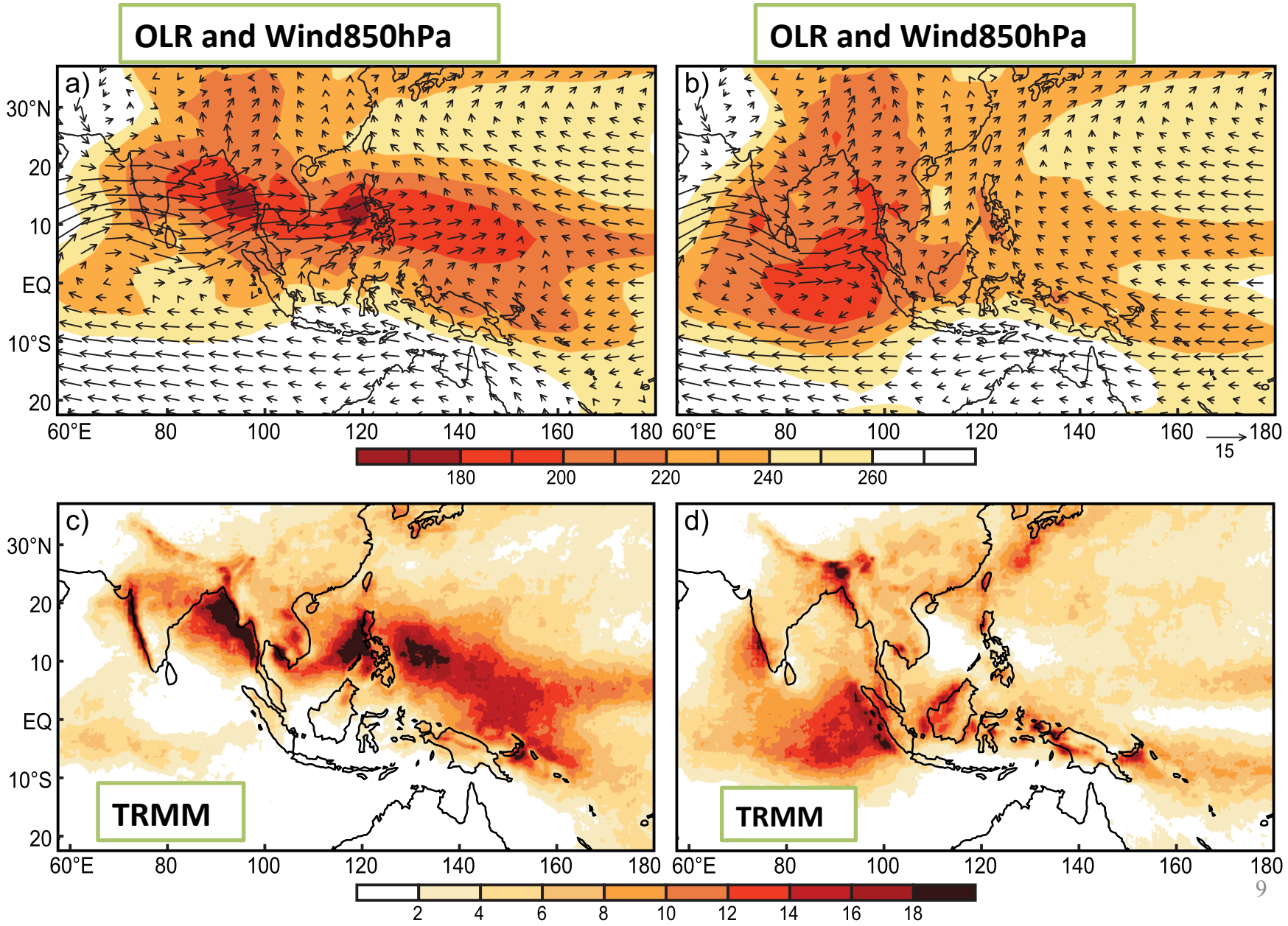



OLR
TRMM rainfall
a)
b)
c)
d)
e)
f)
10
5
0
-5
-10
-15
Jun
15
Jul
15
Aug
15
Sep
15
-5
-4
-3
-2
-1
0
1
2

Standardized meridional profiles of a selection of variables relative to the sloping reference line



Impact of the MISO on the Asian summer monsoon



Model, Experiments and Validated Datasets

- **Model**: CFS v2
- **Hindcast Experiments**:

(**1) Tier-one prediction:** coupled run based on CFSv2

(2) Tier-two prediction: Daily mean SSTs from Tier-1 are prescribed as boundary conditions

In both predictions, (a) ATM/LND/ initial data from CFSRR;

(b) starting from every April during 1982-2009,

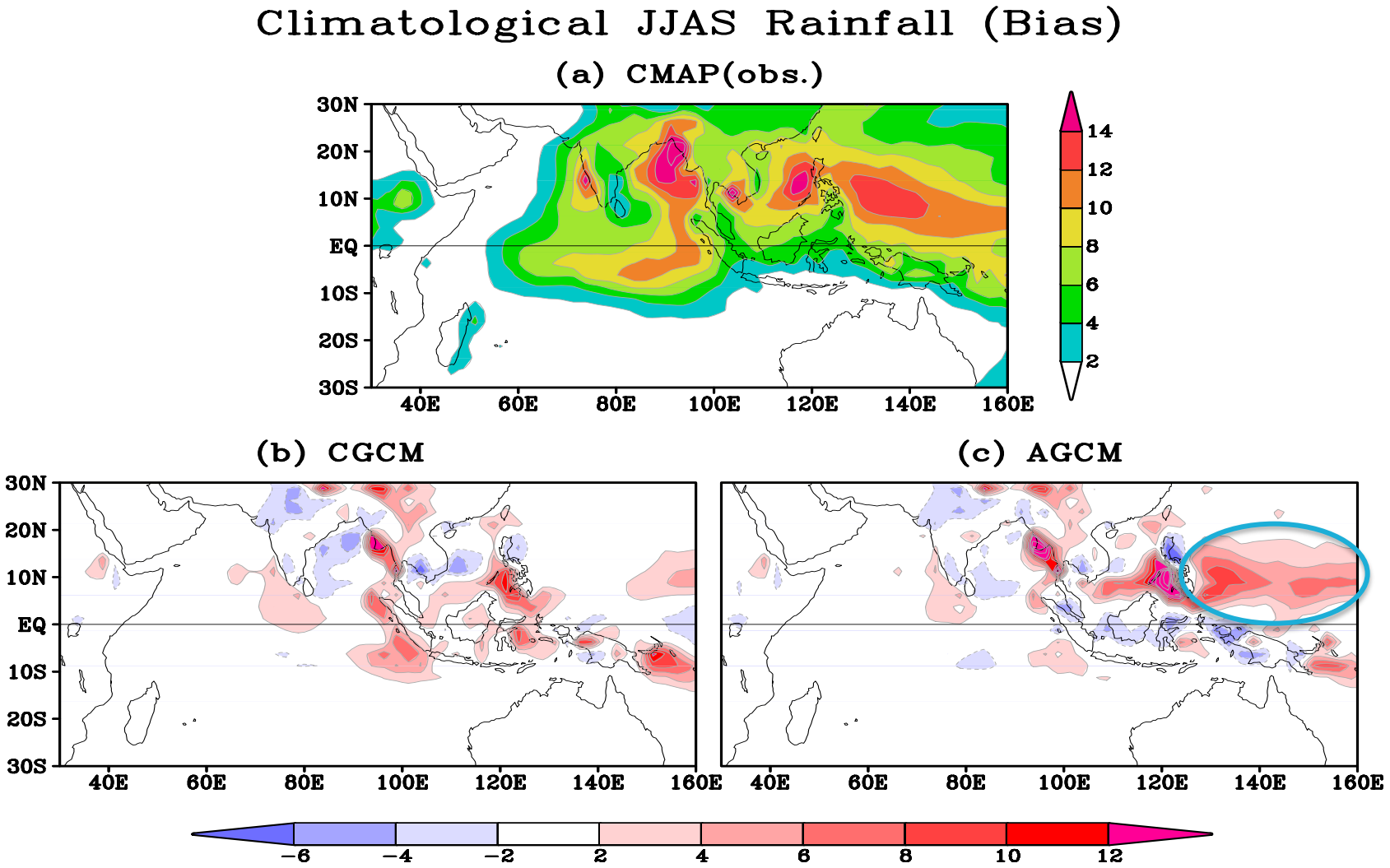
(c) 4 ensemble members with differing in the ATM/LND initial conditions.

Tier-1 vs. **Tier -2:** 6-month hindcasts starting from April (1982-2009)

- **Validated Datasets**:

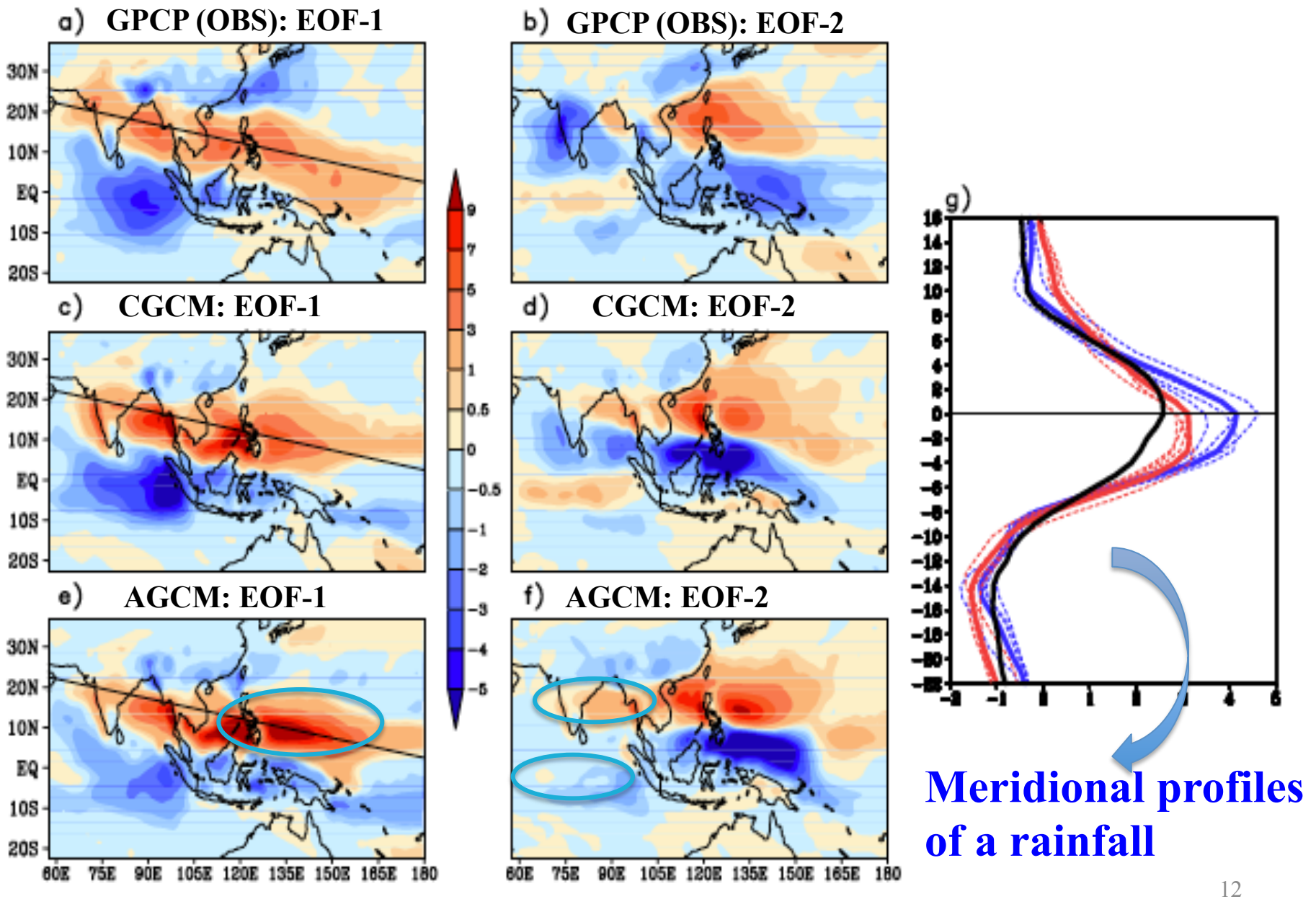
GPCP precipitation dataset (1997 – 2009) (13 Years)

Zhu, J. and J. Shukla, 2013: The Role of Air–Sea Coupling in Seasonal Prediction of Asia–Pacific Summer Monsoon Rainfall. *J. Climate*, **25**, 5689-5697, doi:10.1175/JCLI- D-13-00190.1.

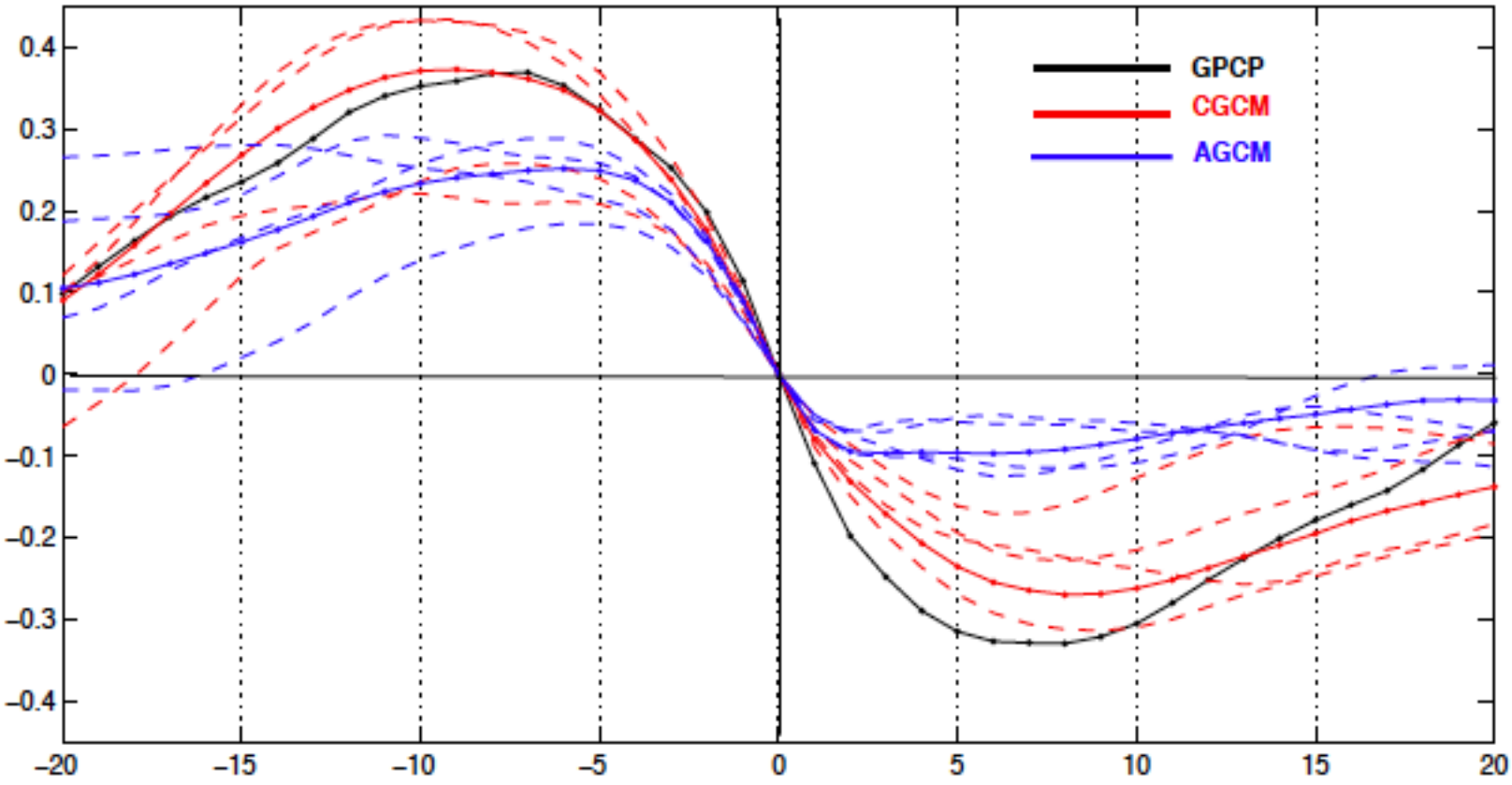


Zhu, J. and J. Shukla, 2013: The Role of Air–Sea Coupling in Seasonal Prediction of Asia–Pacific Summer Monsoon Rainfall. *J. Climate*, **25**, 5689-5697, doi:10.1175/JCLI- D-13-00190.1.

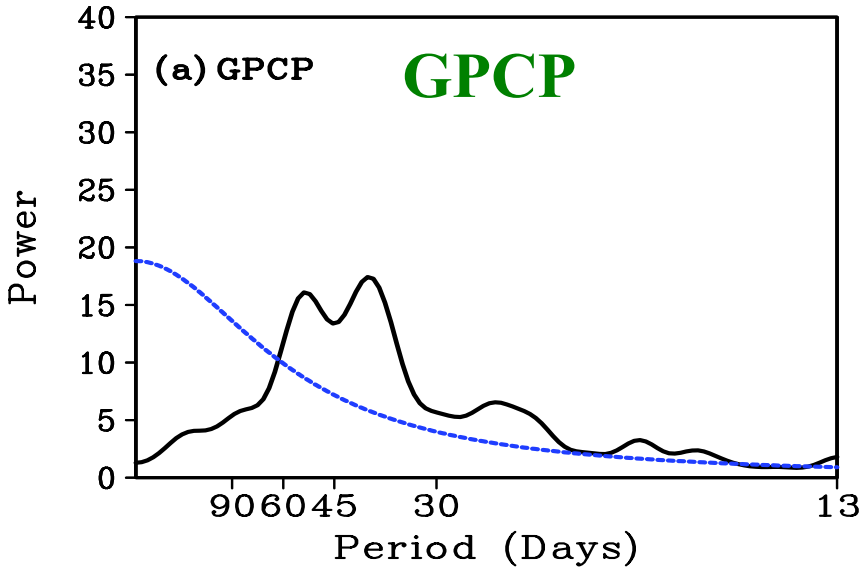
Leading EOF 1, 2 of rainfall anomalies based on daily data for June-September (JJAS)

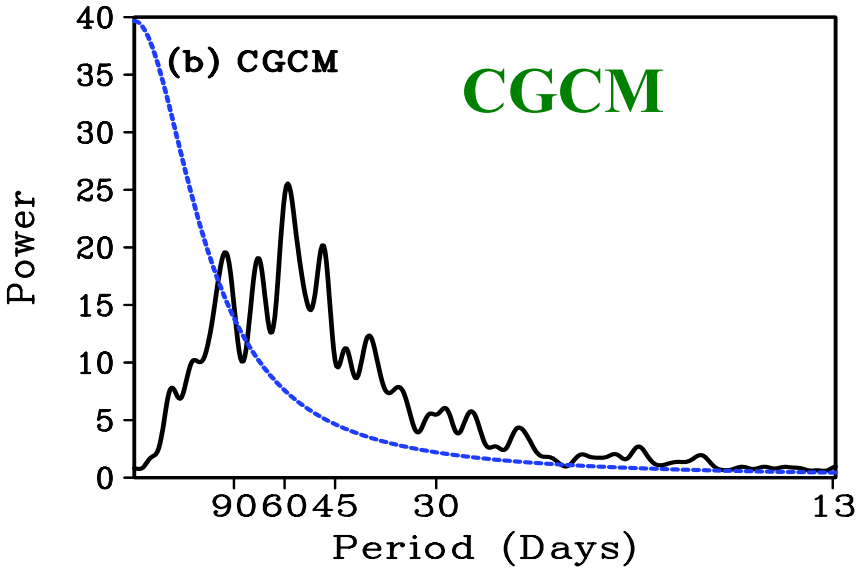


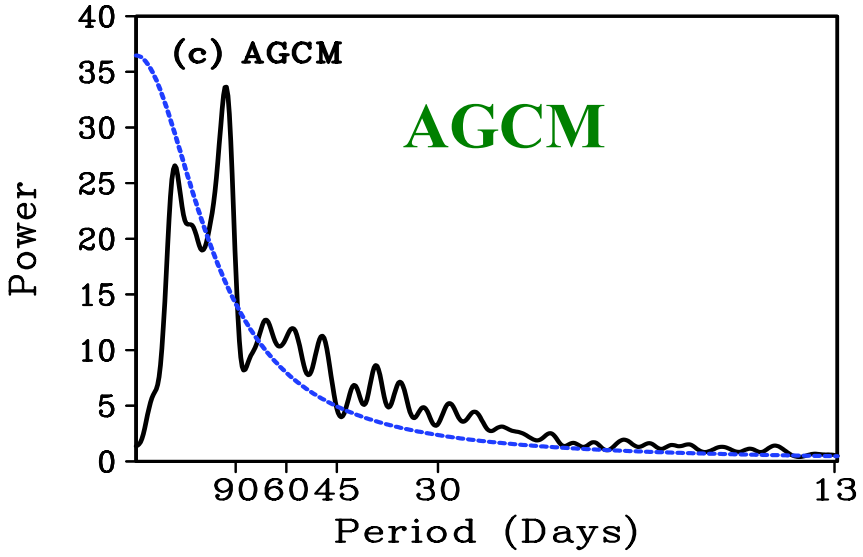
Lead-lag correlation between the two leading principal components (PCs). A lag of +1 indicates PC1 leading PC2 by 1 day.



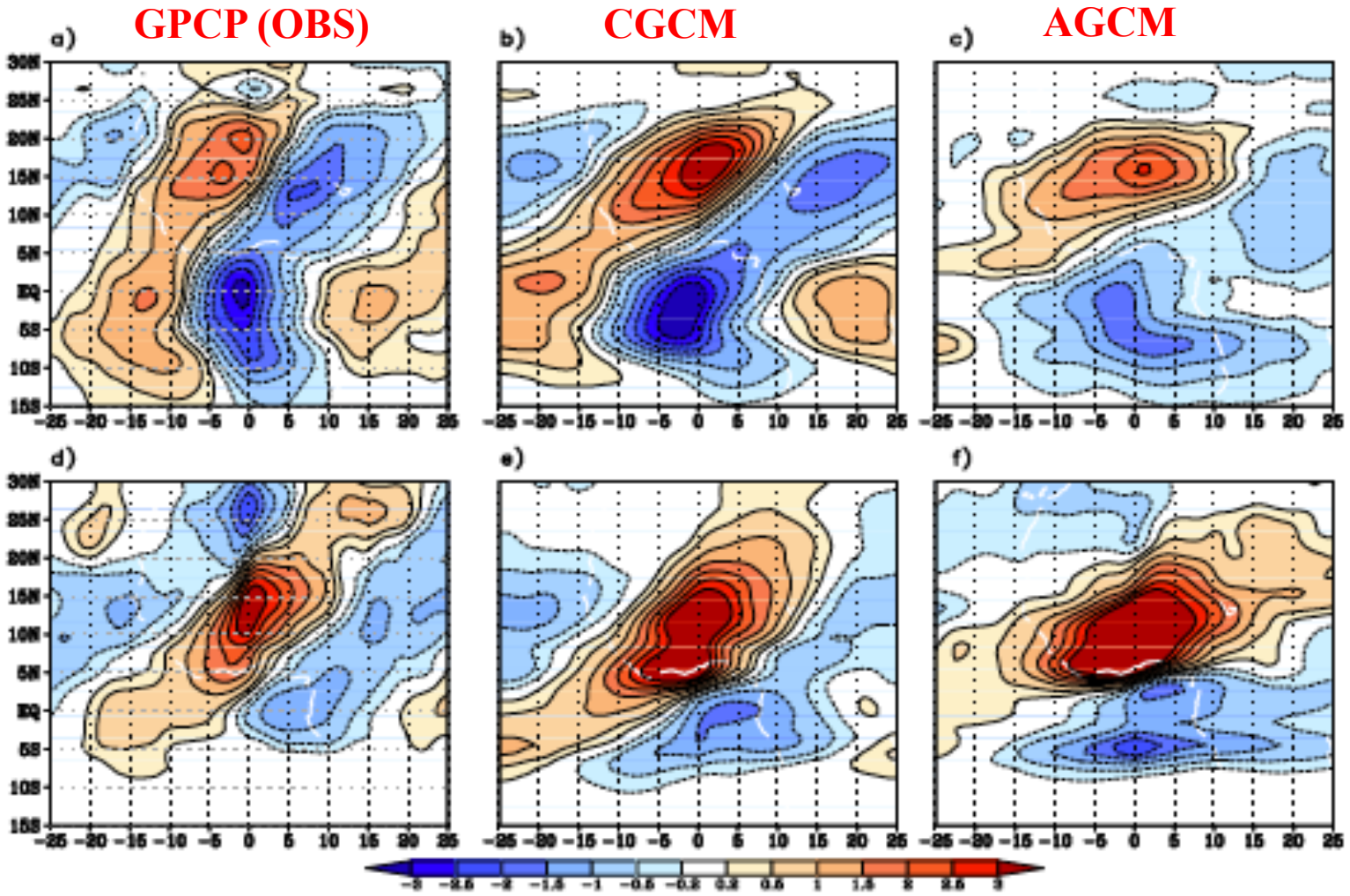
Power spectra of the PCs of the leading two EOFs of the JJAS rainfall



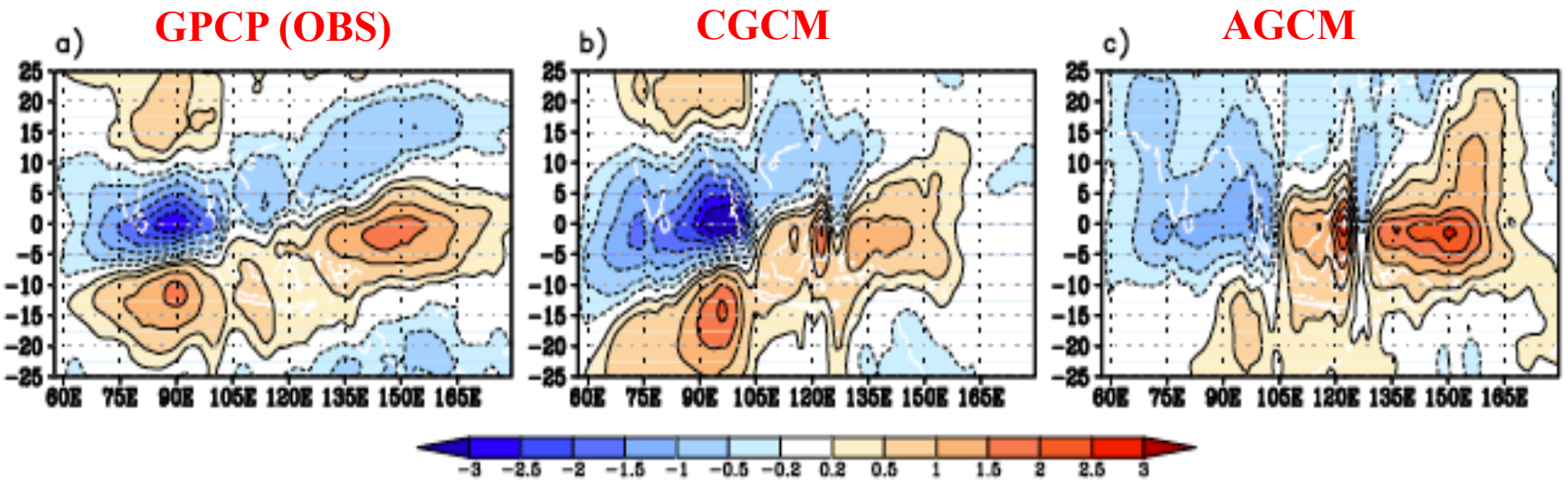




Northward Propagation



Eastward propagation



Conclusion:

- **In the absence of air–sea coupling**, AGCM simulation produces **higher rainfall biases** and unrealistically **high rainfall intraseasonal variations** over western pacific region.

- **MISO simulated** by **CGCM has realistic northward propagation** over Indian and western pacific region, but the **GFS model experiment shows standing mode of MISO over western pacific region and weak northward propagation over Indian subcontinent.**

- **It is encouraging from this study** to observe that some CGCMs **(e.g., CFSv2) have been developed to a stage good enough to capture the role directly**.